

WHAT IS CLAIMED IS:

1. An encrypting device comprising:

key generation means for generating two prime numbers p and q of which product is $n=pq$ as a private key and generating as a public key g_1 and g_2 respectively given by the following Equations (1) and (2) using two random numbers s and t and a maximal generator g in a multiplicative group of integers modulo n ; and

encrypting arithmetic means for, in response to receipt of a plaintext m , generating a ciphertext $C=(C_1, C_2)$ respectively given by the following Equations (3) and (4) using the public key $\{g_1, g_2\}$, a private key n , and random numbers r_1 and r_2 ,

$$g_1=g^{s(p-1)} \pmod{n}, \quad (1)$$

$$g_2=g^{t(q-1)} \pmod{n}, \quad (2)$$

$$C_1=m \cdot g_1^{r_1} \pmod{n}, \quad (3)$$

$$C_2=m \cdot g_2^{r_2} \pmod{n}, \quad (4)$$

where $\gcd\{s, q-1\}=1$ and $\gcd\{t, p-1\}=1$.

2. An encrypting device comprising:

key generation means for generating prime numbers p and q of which product is $n=pq$, where p is a private key, and generating as a public key g_1 given by the following Equation (1) using a random number s and a maximal generator g in a multiplicative group of integers modulo n ;

and

encrypting arithmetic means for, in response to receipt of a plaintext m , generating a ciphertext C given by the following Equation (3)' using the public key g_1 , a private key n , and a random number r ,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$C = m \cdot g_1^r \pmod{n}, \quad (3)'$$

where when information b is a size of p (bits), $0 < m < 2^{b-1}$ and $\gcd\{s, q-1\} = 1$.

3. The encrypting device according to claim 1,
wherein:

e given by the following equation: $e = h(d)$ (h is one-way hash function), where $d = (C_1 + C_2)/m \pmod{n}$, is added to the ciphertext $C = (C_1, C_2)$ so as to be a ciphertext $C = (C_1, C_2, e)$.

4. The encrypting device according to claim 1,
further comprising:

a database for saving data resulting from calculation of a random number portion of the ciphertext C .

5. The encrypting device according to claim 1,
wherein:

the encrypting arithmetic means encrypt only a

plaintext element m_1 , which is a first element in the plaintext m , to the ciphertext element $C_1=(C_{11}, C_{12})$, and ciphertext elements following the ciphertext element C_1 are generated using a received plaintext m_i , bit information of the plaintext m_1 , and two random numbers R_1 or R_2 which are contained in the ciphertext C_1 .

6. A decrypting device wherein included are decrypting arithmetic means for receiving a ciphertext $C=(C_1, C_2)$, which is an encrypted plaintext m , respectively given by the following Equations (3) and (4) using a public key $\{g_1, g_2\}$, a private key n , and random numbers r_1 and r_2 , the private key n being $n=pq$ where p and q are prime numbers generated as a private key, g_1 and g_2 being respectively given by the Equations (1) and (2) using two random numbers s and t and a maximal generator g in a multiplicative group of integers modulo n , and

performing decryption in such a manner so as to generate received ciphertexts a and b respectively given by the following Equations (5) and (6) using the Fermat's little theorem and then derive the plaintext m satisfying the following Equation (7) from the received ciphertexts a and b using the Chinese remainder theorem,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$g_2 = g^{t(q-1)} \pmod{n}, \quad (2)$$

$$C_1 = m \cdot g_1^{r_1} \pmod{n}, \quad (3)$$

$$C_2 = m \cdot g_2^{r_2} \pmod{n}, \quad (4)$$

$$a = C_1 \pmod{p} = m \pmod{p}, \quad (5)$$

$$b = C_2 \pmod{q} = m \pmod{q}, \quad (6)$$

$$m = aAq + bBp \pmod{n}, \quad (7)$$

where $\gcd\{s, q-1\}=1$, $\gcd\{t, p-1\}=1$, $Aq \pmod{p}=1$, and $Bp \pmod{q}=1$.

7. A decrypting device wherein included are decrypting arithmetic means for receiving a ciphertext C of an inputted plaintext m , given by the following Equation (3)' using a public key g_1 , a private key n , and a random number r , the private key n being $n=pq$ where p and q are prime numbers, p being generated as a private key, g_1 being given by the following Equation (1) using a random number s and a maximal generator g in a multiplicative group of integers modulo n , and

performing decryption in such a manner so as to derive the plaintext m satisfying the following Equation (8) using the Fermat's little theorem,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$C = m \cdot g_1^r \pmod{n}, \quad (3)'$$

$$m = C \pmod{p}, \quad (8)$$

where $\gcd\{s, q-1\}=1$.

8. A cryptosystem comprising:

an encrypting device including: key generation means for generating two prime numbers p and q of which product is $n=pq$ as a private key and generating as a public key g_1 and g_2 respectively given by the following Equations (1) and (2) using two random numbers s and t and a maximal generator g in a multiplicative group of integers modulo n ; and encrypting arithmetic means for, in response to receipt of a plaintext m , generating a ciphertext $C=(C_1, C_2)$ respectively given by the following Equations (3) and (4) using the public key $\{g_1, g_2\}$, a private key n , and random numbers r_1 and r_2 ; and

a decrypting device including decrypting arithmetic means for receiving ciphertext elements C_1 and C_2 calculated by the encrypting device and performing decryption in such a manner so as to generate received ciphertexts a and b respectively given by the following Equations (5) and (6) using the Fermat's little theorem and then derive the plaintext m satisfying the following Equation (7) from the received ciphertexts a and b using the Chinese remainder theorem,

$$g_1=g^{s(p-1)} \pmod{n}, \quad (1)$$

$$g_2=g^{t(q-1)} \pmod{n}, \quad (2)$$

$$C_1=m \cdot g_1^{r_1} \pmod{n}, \quad (3)$$

$$C_2=m \cdot g_2^{r_2} \pmod{n}, \quad (4)$$

$$a = C_1 \pmod{p} = m \pmod{p}, \quad (5)$$

$$b = C_2 \pmod{q} = m \pmod{q}, \quad (6)$$

$$m = aAq + bBp \pmod{n}, \quad (7)$$

where $\gcd\{s, q-1\}=1$, $\gcd\{t, p-1\}=1$, $Aq \pmod{p}=1$, and $Bp \pmod{q}=1$.

9. A cryptosystem comprising:

an encrypting device including: key generation means for generating prime numbers p and q of which product is $n=pq$, where p is a private key, and generating as a public key g_1 given by the following Equation (1) using a random number s and a maximal generator g in a multiplicative group of integers modulo n ; and encrypting arithmetic means for, in response to receipt of a plaintext m , generating a ciphertext C given by the following Equation (3)' using the public key g_1 , a private key n , and a random number r ; and

a decrypting device including decrypting arithmetic means for receiving the ciphertext C from the encrypting device and performing decryption in such a manner so as to derive the plaintext m satisfying the following Equation (8) using the Fermat's little theorem,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$C = m \cdot g_1^r \pmod{n}, \quad (3)'$$

$$m = C \pmod{p}, \quad (8)$$

where $\text{gcd}\{s, q-1\}=1$.

10. An encrypting method comprising the steps of:
generating two prime numbers p and q of which
product is $n=pq$ as a private key and generating as a
public key g_1 and g_2 respectively given by the following
Equations (1) and (2) using two random numbers s and t
and a maximal generator g in a multiplicative group of
integers modulo n ; and

in response to receipt of a plaintext m , generating
ciphertext elements C_1 and C_2 respectively given by the
following Equations (3) and (4) using the public key $\{g_1,$
 $g_2\}$, a private key n , and random numbers r_1 and r_2 ,

$$g_1=g^{s(p-1)} \pmod{n}, \quad (1)$$

$$g_2=g^{t(q-1)} \pmod{n}, \quad (2)$$

$$C_1=m \cdot g_1^{r_1} \pmod{n}, \quad (3)$$

$$C_2=m \cdot g_2^{r_2} \pmod{n}, \quad (4)$$

where $\text{gcd}\{s, q-1\}=1$ and $\text{gcd}\{t, p-1\}=1$.

11. An encrypting method comprising the steps of:
generating prime numbers p and q of which product
is $n=pq$, where p is a private key, and generating as a
public key g_1 given by the following Equation (1) using a
random number s and a maximal generator g in a
multiplicative group of integers modulo n ; and

in response to receipt of a plaintext m , generating a ciphertext C given by the following Equation (3)' using the public key g_1 , a private key n , and a random number r ,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$C = m \cdot g_1^r \pmod{n}, \quad (3)'$$

where when information b is a size of p (bits), $0 < m < 2^{b-1}$ and $\gcd\{s, q-1\} = 1$.

12. A decrypting method comprising the steps of:
receiving a ciphertext $C = (C_1, C_2)$, which is an encrypted plaintext m , respectively given by the following Equations (3) and (4) using a public key $\{g_1, g_2\}$, a private key n , and random numbers r_1 and r_2 , the private key n being $n = pq$ where p and q are prime numbers generated as a private key, g_1 and g_2 being respectively given by the Equations (1) and (2) using two random numbers s and t and a maximal generator g in a multiplicative group of integers modulo n ; and

performing decryption in such a manner so as to generate received ciphertexts a and b respectively given by the following Equations (5) and (6) using the Fermat's little theorem and then derive the plaintext m satisfying the following Equation (7) from the received ciphertexts a and b using the Chinese remainder theorem,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$g_2 = g^{t(q-1)} \pmod{n}, \quad (2)$$

$$C_1 = m \cdot g_1^{r1} \pmod{n}, \quad (3)$$

$$C_2 = m \cdot g_2^{r2} \pmod{n}, \quad (4)$$

$$a = C_1 \pmod{p} = m \pmod{p}, \quad (5)$$

$$b = C_2 \pmod{q} = m \pmod{q}, \quad (6)$$

$$m = aAq + bBp \pmod{n}, \quad (7)$$

where $\gcd\{s, q-1\}=1$, $\gcd\{t, p-1\}=1$, $Aq \pmod{p}=1$, and $Bp \pmod{q}=1$.

13. A decrypting method comprising the steps of:
receiving a ciphertext C of an inputted plaintext m ,
given by the following Equation (3)' using a public key g_1 ,
a private key n , and a random number r , the private key n
being $n=pq$ where p and q are prime numbers, p being
generated as a private key, g_1 being given by the following
Equation (1) using a random number s and a maximal
generator g in a multiplicative group of integers modulo n ;
and

performing decryption in such a manner so as to
derive the plaintext m satisfying the following Equation (8)
using the Fermat's little theorem,

$$g_1 = g^{s(p-1)} \pmod{n}, \quad (1)$$

$$C = m \cdot g_1^r \pmod{n}, \quad (3)'$$

$$m = C \pmod{p}, \quad (8)$$

where $\gcd\{s, q-1\}=1$.